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It is with deep regret we have to announce the death of Viscount Harcourt from heart failure on February 24th. Lord Harcourt had been Chairman of the Honorary Committee of Management of the Bureau of Mycology since its inception, and had taken keen interest in the organization and working of the Bureau. His loss will be deeply felt.

SPEARE (A. T.). **Massospora cicadina Peck, a Fungus Parasite of the Periodical Cicada.**—*Mycologia*, xiii, pp. 72–82, 2 pl., 1921.

The periodical cicada, *Tibicina septemdecim*, passes sixteen years and nine months of its existence subterraneously. It nevertheless bears a parasite not known to occur upon any other host. The fungus is largely confined to male insects. Conidia were found on cicadas early in the season, and are oval, 10–14 × 14–17 μ, papillate, and verrucose. They germinate by germ tubes, but the writer was unsuccessful in culturing the fungus artificially. Later in the season resting spores were found on 50 to 90 per cent. of the males. These azygospores are spherical, brownish, reticulated bodies, 38–48 μ in diameter. Attempts to germinate them failed. The fungus belongs to the Entomophthorales, and may possibly develop on biennial cicadas, although it has not been found on these so far, nor upon the larvae of *T. septemdecim*. It is not known how it is perpetuated.

RAYBAUD (L.). **Sur un Fusarium parasite de quelques Mucorinées.** [On a *Fusarium* parasitic on some Mucorineae.]—*Comptes rendus de la Soc. de Biol.*, lxxxiv, 4, pp. 213–215, 1921.

The writer describes the parasitism of a *Fusarium* on cultures of *Phycomyces nitens*, *Mucor mucedo*, and *Rhizopus nigricans*.

The fungus originated on potato-peel, and is probably a variety of *F. solani*. It will not germinate on acid media, e. g. orange-juice, and prefers the young parts of the hosts where the protoplasm is dense.

TRAVERSO (G. B.). **Cenni su l'industria degli anticrittogamici e degli insetticidi in Italia.** [Notes on the fungicide and insecticide industry in Italy.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 5–6, pp. 51–63, 1921.

In a general summary of the position of the fungicide and insecticide industry in Italy, the author states that the use of CAFFARO PASTE and CAFFARO POWDER has, since 1912, replaced in part that of Bordeaux mixture in Italy. The paste is prepared with oxychloride of copper, which salt was formerly used as a fungicide in Switzerland and France under the name of 'Cuprose'. From a practical point of view Caffaro paste offers over Bordeaux mixture the advantage of containing the exact proportion of lime, so that it needs only to be dissolved in the prescribed volume of water in order to have the mixture ready for use. It is true that Caffaro paste contains only 16 per cent. of metallic copper, instead of the 25 per cent. contained in the copper sulphate of Bordeaux mixture, but it has been proved by ten years' use that its efficiency as a fungicide is more or less equal to that of the ordinary mixture.

In 1919 further progress was effected by the appearance in the market of Caffaro powder, which is nothing more than Caffaro paste reduced to an extremely fine powder. It can be used either for liquid treatment by dissolving it in water in the proportions needed, or for dry pulverizations, which are recommended especially in regions where lack of water renders the use of liquid mixtures expensive. The great advantages presented by Caffaro powder from the point of view of facility of manipulation, packing, and forwarding, should cause it gradually to supplant completely the paste.

BORDEAUX POWDER ('Polvere bordolese') is still under trial and its practical value has not yet been established. [See next abstract.]

Italy is the country producing the largest quantity of sulphur after the United States, and, in addition to its use in the form of sublimed sulphur and the like, various other preparations are extensively employed, viz.:

CUPRIC SULPHUR ('Zolfo ramato').—Sulphur to which from 3 to 10 per cent. of sulphate of copper, reduced to a fine powder, has been added; it is used either pure or with the addition of inert powders such as talc, gypsum, lime, steatite, &c., to reduce the cost of treatment especially in slighter attacks of fungi.

'VITTORIA' POWDER.—A cupric sulphur powder of a patented formula, containing 3, 5, 8, or 10 per cent. of sulphate of copper and 40 per cent. of some inert impalpable powder not commonly used, which increases the adhesiveness of the preparation, so that in many cases it can be usefully employed instead of liquid treatments. It has found favour with the Italian vine-cultivators and its use is spreading.

CALCIUM-POLYSULPHIDES (or lime-sulphur mixture).—Prepared, in Savastano's method, by boiling a mixture of 10 kg. of lime and 20 kg. of sulphur in 25–30 litres of water for about one hour. The mixture thus obtained is diluted to 5 per cent. for summer and 8 or 10 per cent. for winter treatments. Its use gives good

results. Various proprietary forms have been manufactured on an industrial scale in Italy of recent years, but do not seem to be extensively used.

SUPER-SULPHUR ('Supersolfo') is a calcium polysulphide which appeared under this name on the market in 1920; it is a liquid super-concentrated mixture, at 35° to 40° Beaumé, of polysulphides. It is diluted to 2 per cent. for summer and 4 per cent. for winter treatments, and has a strengthening action on the plants, as it contains a certain quantity of soluble iron. It is prepared from by-products of gas-manufacture and has met with success.

Professor Bruttini has lately produced a cupric super-sulphur which has given satisfactory results at the first test, and experiments are now being carried on with it.

CERASOLI (E.). **Il problema nazionale degli anticrittogamici base di rame.** [The national problem of copper fungicide preparations.]—*Boll. mensile della R. Staz. di Patologia vegetale*, ii, 5–6, pp. 64–71, 1921.

Bordeaux powder, as prepared by the author, is made by adding to a milk of lime (containing 10–15 per cent. of calcium hydrate) about 4 per cent. of chloride of calcium. Into this mixture is allowed to fall little by little and uninterruptedly, while stirring, a solution of sulphate of copper at 20° to 22° Beaumé until neutralization as indicated by phenolphthaleine. This gives a precipitate which filters without washing and is then dried in a current of air at 90° to 100° C. The preparation is claimed to have all the properties of Bordeaux mixture.

The preparation of Bordeaux powder does not entail appreciable waste of material, seeing that the reaction between the sulphate of copper and milk of lime produces the slightly soluble sulphate of calcium which has the property, amongst others, of prolonging the life of the leaf.

In order to increase the suspension of the powder, 10 per cent. of a paste made from infusorial earth and sugar-factory residues is added. Like Caffaro powder (details of the manufacture of which are given) Bordeaux powder contains 16 per cent. of copper, but its cost is lower because of simplicity of manufacture and less waste. Both these powders are cheaper than Bordeaux mixture.

DALMASSO (G.) & SUTTO (S.). **Prove di rimedi contro le crittogame della vite.** [Tests of fungicides for vine diseases.]—*Il Coltivatore*, lxvii, 12–13, pp. 364–368 and 395–399, 1921. Abs. in *Boll. mensile della R. Staz. di Patologia vegetale*, ii, 5–6, pp. 77–78, 1921.

The authors, of the Royal School of Viticulture, Conegliano, state that the treatment of the vine with dry powders only, in regions with frequent rainfall, is not sufficient against *Peronospora*, but that they can be very useful as a complementary means of checking the fungus, if alternated with liquid treatments. Bordeaux mixture remains the chief remedy, and the one per cent. formula gives sufficiently good results to justify its use rather than the stronger and more costly mixtures. Caffaro powder in solution of one per cent. gives results but little inferior to Bordeaux mixture.

The preparation known as 'Supersolfo' has not given satisfactory

results against *Oidium*, but further tests are required as to the best method of applying it.

THOMPSON (N. F.). **The Effect of certain Chemicals, especially Copper Sulphate and Sodium Chloride, on the Germination of Bunt Spores.**—Abs. in *Phytopath.*, xi, 1, p. 37, 1921.

Copper sulphate, one lb. to five gallons of water, for one minute to one hour did not prevent germination of spores of *Tilletia laevis* and *T. tritici*, but only retarded it. But copper sulphate and sodium chloride inhibited germination of the spores at a strength of only one lb. of each to 100 gallons water.

MACKIE (W. W.) & BRIGGS (F. N.). **Chemical Dusts for the Control of Bunt.**—Abs. in *Phytopath.*, xi, 1, p. 38, 1921.

Copper carbonate dust, and equal parts of copper sulphate and calcium carbonate applied as a dust, each gave perfect control of *Tilletia tritici* when applied to the wheat seed at the rate of two ounces per bushel.

WERTH (E.). **Phänologie und Pflanzenschutz.** (Phenology and Plant Protection.)—*Zeitschr. für Pflanzenkrankh.*, xxxi, 3–4, pp. 81–89, 1921.

When the organization of a Plant Protection Service was started in Germany endeavours were made to gain some knowledge of the relationship, undoubtedly existing in many cases, between the occurrence of plant diseases, especially of widespread epidemics, and meteorological conditions. No general conclusions can, however, be drawn from this work, as no uniform plan was followed, and a direct proof of such a connexion is still wanting. The attempt to develop international observations made in 1913 by the International Institute of Agriculture in Rome was shattered by the Great War.

With the foundation of a laboratory for Meteorology and Phenology at the Biologische Reichsanstalt, Berlin, the investigation of the connexion between plant diseases and weather conditions has entered a new stage. A centre has been created where will be registered (through a system of report cards) the incidence of diseases and pests throughout Germany, with the phenological data required to trace their relation to weather factors; this will undoubtedly lead to new and more secure methods of handling their control.

Phenology (i. e. the observation of the annual development phases of plants or animals) can help towards attaining this end by studying the pathogenic organisms themselves from a phenological point of view, and drawing a parallel between their behaviour in the course of a particular year, or on an average of a number of consecutive years, and meteorological data such as the isothermic lines.

Examples of the correlation between diseases and weather conditions are given. Thus *Monilia* attacks primarily the ovaries of the dead blossoms of fruit-trees, and such blossoms are killed chiefly by late spring frosts; *Fusicladium* is less discriminating, and its preference for immature parts of fruit-trees indicates the danger of a cold spring; a long-delayed spring causes a delay in the sowing and favours the attacks of hoppers on young cereals;

the same may occur when the sowing is made in its right time, by a delayed growth due to drought.

Phenology can also be of considerable practical interest to plant-growers, as it can help towards the immediate selection of resistant and sufficiently productive varieties to be cultivated in a given locality under known climatic and soil conditions, without losing years in unsuccessful trials.

As it would take many years to organize regular observations of all known pests, it is necessary at first to select only a few of the most widespread and best-known vegetable and animal forms which are easy to observe and may be considered as typical representatives. Thus a standard will be obtained which will allow of conclusions being drawn regarding the behaviour of other ecologically similar forms.

General plant and animal phenology can be very helpful to the Plant Protection Service and may lead to the discovery of further cases of 'indicators', that is of associations between some easily observed phenological phenomenon and the severity of a disease-outbreak. Thus according to Hiltner: 'There seems to be a striking interdependence between the dates at which snowdrops bloom and the seriousness of the plague of field-mice which occurs from time to time in Bavaria.'

Furthermore, phenological observations will undoubtedly render more clear the combined action of climate and soil on plants. There is already convincing evidence that, under similar climatic conditions, the general type and annual developmental course of vegetation is closely dependent on the quality of the soil, but still there is much to be learned, especially regarding the influence of soil on disease. Thus it is stated that the plum-pocket disease (*Taphrina pruni* Tul.) and the red spot of plum leaves (*Polystigma pruni* Tul.) hardly ever occur on lime-rich soils, while in lime-poor soils or where no lime at all is present they can occasion heavy damage. A rainy and warm summer will favour the development of the *Phytophthora* stem and tuber-rot of potato to such an extent that, in heavy soils, up to 50 per cent. of the tubers can easily be rotted, but in a light soil the formation of tubers is stimulated by such weather, so that the damage done by *Phytophthora* can be counterbalanced and a good crop obtained.

The author therefore advocates the creation of a National Phenological Service over the whole of Germany, which in time will be able to determine the laws of the interdependence between climatic variations during a number of years, and the increase or decrease in the intensity of diseases and pests of cultivated plants; this service will ultimately aim at giving warning of a threatening plague or epidemic, and preventive and control measures can be taken in good time.

There exists already in Germany a network of official and private institutions which might be called upon to help in the organization of a regular and uniformly planned phenological service. In Bavaria there has been, since 1912, a phenological observation service with the Chief Station for Plant Protection in Munich as centre; in Württemberg also phenology has long been a part of the activity of the Meteorological Central Station (Provincial Bureau of Statistics), while in Saxony phenological obser-

vations are collected and published by the Central Meteorological Office. In Mecklenburg the State Bureau of Statistics also collects phenological notes, which are published periodically.

The author suggests the following bases for the observations:

1. Observations on a small selection of characteristic plants, the selection being made on the ground of already available experience, so as to permit of determining with certainty all the phenological phases in the course of the plant year.

2. A short list of observations on the animal kingdom, comprising five points only.

3. Observations on a series of animal and vegetable parasites.

Reports should be made at the end of spring and summer, with a general report at the end of the year, and should be sent in as early as possible to the co-ordinating centres.

BROCQ-ROUSSEU (M.). **Les recherches mycologiques en médecine vétérinaire.** [Mycological Research in Veterinary Medicine.] —*Bull. Soc. Myc. de France,* xxxvii, 2, pp. 99–103, 1921.

The War Minister installed in 1920, at 8 Avenue de Ségur, Paris, a laboratory for veterinary research for the Army, which has for its particular object the study of contagious and parasitic diseases of the horse, their prevention and cure. The author calls attention to several diseases of fungous origin as being deserving of further study. Some of them are common to man and the horse, and are thus important from the point of view of comparative pathology. From the purely mycological standpoint their full life-history and relations are in need of further investigation. The skin diseases, of which ringworm is a type, due to *Achoriôn gypseum, Microsporon lanosum, M. equinum, Trichophyton gypseum, T. equinum, T. gypseum granulatum,* and others, are of interest to mycologists as their perfect stages, usually believed to be probably of the Gymnoascaceous type, are not known, nor under what conditions they can occur in nature as saprophytes. Sporotrichosis, due to *Sporotrichum Beurmani,* is perhaps transmissible from the horse to man by contact. Epizootic Lymphangitis, the causal organism of which is a *Cryptococcus* which in culture has given indications of a mycelial development, is worthy of much more detailed mycological study. Then there is the group of forms variously known as *Streptothrix, Actinomyces, Discomyces, Nocardia, Oospora, Cladothrix,* &c., which are in a most regrettable state of confusion as regards their nomenclature. Here again some are common to animals and man.

It would also be of great practical value to determine the identity of the numerous fungi affecting fodder and causing alterations which may lead to intoxication. The chemical changes they bring about should be of particular interest.

KEILIN (D.). **On a New Type of Fungus: Coelomyces stegomyiae n. g., n. sp., parasitic in the Body-cavity of the Larva of Stegomyia scutellaris Walker (Diptera, Nematocera, Culicidae).**—*Parasitology,* xiii, 3, pp. 225–234, 7 figs., 1921.

Among six parasitized larvae of *Stegomyia scutellaris,* collected by Dr. Lamborn in the Federated Malay States, one harboured a new parasite which was very similar in appearance to a new ciliate

Lambornella described in the same journal (pp. 216–224). A detailed study of the structure of this parasite, however, showed that the organism was a fungus, which the author proposes to name *Coelomyces stegomyiae* n. g., n. sp. The examination of sections showed that the larva was heavily infected and lacked one gill, while the fat-body had completely disappeared. The other internal organs were apparently healthy.

The infected portions of the parasitized larva contained oval bodies, 37·5 to 57 μ long by 20 to 30 μ in breadth, surrounded by a more or less thick yellowish wall. Fragments of a true mycelium were also seen, forming two or three concentric layers so closely attached to the host tissues that there was difficulty in separating them. The mycelium was also well developed beneath the hypoderm of the host, where it was covered with the pigmented remains of the peripheral cells of the fat-body. The numerous branches varied from 2 μ to 6 μ in thickness, the main ones being often connected by short transverse branches which showed a small diverticulum or spherical thickening in places. The mycelium was unicellular, the nuclei being crowded or scattered.

The majority of the branches show terminal multinucleate thickenings of various sizes, sometimes as much as 30 to 35 μ by 20 to 22 μ. Later these become separated from the mycelium and are found within the body-cavity of the insect, their length varying from 32 to 65 μ. At a still more advanced stage these bodies become more regularly oval, the peripheral layer of protoplasm grows denser, the external wall thickens, the nuclei increase in number, and the protoplasm becomes more basophile. Finally they become sporangia which measure 37·5 to 57 μ by 20 to 30 μ, and are flattened on one side and convex on the other. The wall of the sporangium, highly magnified, shows a very fine granular structure and many small clear lenticular spots. This wall consists of two distinct layers: (1) an internal, thin, structureless layer, 0·7 μ thick, and (2) an external layer, 1·7 to 2 μ thick, of a yellowish colour and showing numerous apertures, from which oily drops are extruded.

The young sporangium is filled with very dense basophile protoplasm, containing a number of small nuclei. As it develops, the protoplasm divides into many portions, each surrounding a nucleus, and gives rise to as many small spherical cells as there were nuclei. These cells, 3 μ in diameter, become elongated, and ultimately the sporangia are filled with lozenge-shaped spores, 5 μ long by 1 μ in diameter. The escape of the spores probably results from the rupture of the sporangium along the clearly-marked line of cleavage visible on its convex surface. Thin- and thick-walled sporangia were found, both these forms being independent of the stage and content of the sporangia. Possibly the former serve for immediate reproduction, while the latter represent a resistant or resting form of the parasite.

The systematic position of this organism is somewhat obscure. The mycelium of *Coelomyces* being devoid of transverse walls, it would appear to belong to the Phycomycetes, and undoubtedly resembles the Chytridineae in some respects. Its systematic position cannot be exactly defined, however, until more abundant and living material is available for study. It is still necessary to determine

(1) the structural character of the mycelium during the early stages of infection, before its more or less complete transformation into sporangia; (2) whether conjugation occurs, and if so, at what stage of development; (3) the structure of the spores; (4) the mode of their liberation from the body of the host; and, finally, (5) the mode of infection of a new host and the formation of the first mycelium.

POLITIS (J.). **Du rôle du chondriome dans la défense des organismes végétaux contre l'invasion du parasitisme.** [Part played by the Chondriom in the Self-defence of Plant Organisms against Parasitic Invasion.]—*Comptes rendus de l'Acad. des Sciences*, clxxiii, 8, pp. 421–423, 1921.

The presence of a parasite in the interior of tissues very frequently provokes an irritation which manifests itself by a reaction in the part attacked. The author believes that the chondriom plays a considerable part in these reactions.

The leaves of *Euonymus* bear, when they are attacked by *Oidium euonymi-japonici* in the spring, large red blotches on both sides, caused by the action of the mycelium, which sends haustoria into the interior of the epidermal cells. The excitation provoked by the mycelium can be transmitted to some distance, for the red discoloration, due to an anthocyanic pigment dissolved in the liquid contained in the vacuoles, is also observed in cells quite free from haustoria. In order to explain this action at a distance, one is naturally led to admit the diffusion of an irritating principle exosmosed by the parasite. In other cases the reaction which takes place seems to be the more or less direct result of an irritation of the mitochondria, and, as a matter of fact, mitochondria are present in the cytoplasm of the cells in which the trouble starts. Most of these elements participate in the formation of the anthocyan, and of the colourless tannic compounds which are found in the diseased parts of various plants. In several parasites which produce a set of symptoms closely resembling the well-known 'brunissure', such as the *Oidium* disease of the vine, one can ascertain that the brown spots are always due to the action of the mitochondria, which produce a brown tannic compound.

In another set of cases the chlorophyll persists longer in the diseased areas of organs where it disappears normally at a given time, than in the sound ones. So, for instance, leaves of apple and arbutus, which normally are yellow when they fall, often show green patches in the areas attacked by *Fusicladium dendriticum* or *Septoria unedonis*. The same occurs also under scale insects; small green spots can thus be observed on oranges attacked by *Chrysomphalus minor*. The long persistence on the trees of leaves attacked by a parasite must also be ascribed to a parasitic excitation, as is, for instance, the case with lilac bushes on which the leaves attacked by *Aspidiotus hederae* remain during the whole winter (Trabut). In all these cases it can be proved that the parasitic invasion has an exciting action on the chloroplasts, which, according to recent views, are nothing more than highly differentiated mitochondria. The examination of a transverse section shows that the cells in these green areas contain chloroplasts which increase in

size, multiply by division, and actively produce chlorophyll and starch, while the cells in the sound areas either contain degenerating chloroplasts or are wholly without them.

When the action of the parasite results in the formation of true galls, the irritability of the mitochondria is very acute; a good example of this is given by certain bluish galls on the leaves of *Lycium europeum* L. In the epidermal tissue of the galls the cytoplasm of the youngest cells contains a bright corpuscle of an oleaginous aspect. These represent the cyanoplasts described by the author in the epidermal cells of various flowers, and are derived from mitochondria (Guillermond). At first they are colourless and very small, but they gradually increase in size until they equal or even outgrow the size of the nuclei, and then become impregnated with a bluish-purple colouring matter. In this case it is therefore quite evidently proved that parasitic invasion causes an excitation resulting in the growth in size of mitochondria which produce an anthocyanic pigment. The formation of large quantities of tannin in galls must also be attributed to a similar excitation.

Thus the excitation in plants caused by a parasite can give rise to a state of reaction in the mitochondria, which become active centres for the elaboration of most of the substances secreted by the cell; some of these substances, e. g. tannin compounds, can be produced in large quantities, and probably contribute to the self-defence of plant organisms against parasitic invasion. The reaction in the mitochondria varies in different plants or even in the same plant in accordance with its stage of development and the nature of the parasite.

ALCOCK (Mrs. N. L.). **Protection against Fungi from Abroad.**—*Journ. of the Ministry of Agric.*, xxviii, 7, pp. 455–459, 4 pl., 1921.

The new Destructive Insects and Pests Order of 1921 has been framed to prevent the entrance of certain dangerous parasites into England. Two of these—wart disease of potatoes and onion smut —are already in this country, but their distribution is known and their control is dependent on this knowledge being reliable, so that new introductions are undesirable. The other scheduled diseases have so far not made their appearance, and it is hoped that the new Order will prevent their introduction. They are four in number. Chestnut blight (*Endothia parasitica*) is a bark disease which has caused losses in the United States reaching many million pounds sterling, and all efforts to control it have proved fruitless. Downy mildew of hops (*Peronoplasmopora humuli*) was imported from Japan into the United States and is there spreading. Fire blight, a bacterial disease due to *Bacillus amylovorus*, has been stated to be the most universally destructive of all pomaceous fruit diseases, and in the United States the growing of susceptible pears has been rendered unprofitable by it in some localities. Black knot of plum and cherry (*Plowrightia morbosa*) abounds on the wild plums and cherries in the United States, and is as destructive as it is common. Other diseases occur in various parts of the world that may become extremely destructive to cultivated plants if introduced into England, but these four are of outstanding importance.

UPHOF (J. C. T.). **Eine neue Krankheit von Cephalanthus occidentalis.** [A new disease of *Cephalanthus occidentalis.*]—*Zeitschr. für Pflanzenkr.*, xxxi, 3–4, pp. 100–108, 1 fig., 1921.

A disease of the shrub *Cephalanthus occidentalis* (Rubiaceae) is described, which the writer found in 1918 near Poplar Bluff, Missouri, U.S.A. It is believed to be a form of mosaic disease. No similar affection, so far as the writer knows, has been hitherto observed on the Rubiaceae.

The soil was a fertile clay, very liable to flooding, and in some parts practically a swamp. There were entire rows composed of these shrubs with the characteristic mottling of the leaves, while others again were quite green and normal. To all appearance the disease radiated out from a given point, and was presumably connected in some way with the early summer floods.

The young leaves, 3 to 10 cm. in length, were of a normal pale green colour, but dotted with small light spots. The latter gradually increase in size with the growth of the leaf, and finally merge into one another, thus forming large irregular patches from 3 to 30 mm. in diameter. All parts of the leaf—base, centre, veins, and tip—are liable to attack, as are also the pedicels, young branches, and roots.

The disease appears to result in an elimination of the chlorophyll grains. Neither insect nor fungous parasites could be detected, while bacteria were also absent.

The structural differences found between healthy and mosaic tobacco-plants, one of the foremost of which is the feeble development of the palisade parenchyma in affected leaves, appear to be absent in the case of *Cephalanthus*. Transverse sections of a *Cephalanthus* leaf in a fairly advanced stage of the disease show that some of the chloroplasts are normal in colour, while others are much lighter. All, however, are of the same size. The virus appears to be diffused from the centre of the spots, and to be conveyed by means of the protoplasm to the chloroplasts. Gradually, as the disease advances, the chloroplasts divide irregularly, and the last stage of infection is characterized by the total degeneration of the chlorophyll grains and the presence of large grains of starch. The corresponding parts of the leaves are very transparent.

Inoculation experiments were successfully carried out, the average duration of the incubation period being 12 to 14 days. Healthy parts of the plant could be infected by the virus, which was filtered through cotton or paper. A temperature of 100° C. kills the virus, which survives 60° C. The actual thermal death-point has not been ascertained. All attempts to inoculate other plants of various families were unsuccessful.

BLAKESLEE (A. F.). **A Graft-infectious Disease of Datura resembling a Vegetative Mutation.**—*Journ. of Genetics*, xi, 1, pp. 17–36, 5 pl., 1921.

Plants of the Jimson Weed (*Datura stramonium*) have been found to develop spontaneously a peculiarity which can be transmitted by grafting to normal stocks. Such plants are called *Quercina* on account of structural characteristics of the

leaves. The first *Q.* plant was found in the cultures at the Connecticut Agricultural College in the autumn of 1915, and was then believed to be a spineless mutant of the purple-stemmed form. Seed was obtained for experimental purposes by means of artificial pollination.

The *Q.* plants do not breed true, but throw a small proportion of normal plants along with *Q.* seedlings. The latter are usually recognizable at an early stage, the leaves being narrower than the normal, somewhat twisted, and indented at the margins. The stature of *Q.* plants is below the normal, the branches are more slender, and the root system not so well developed. The flowers are also easily distinguishable from the normal. The corolla is split between the lobes as far down as the insertion of the filaments, the segments being incurved and twisted around the base of the flower. In the expansion of the bud they are frequently unable to free themselves from the calyx. The colour of the flower is darker than the normal, while the stem colour is also more intense. The stamens in the bud are shrivelled, and produce only a few small grains which do not function. The stigmatic surface is chiefly on the inside of the lobe, and runs part of the way down two sides of the style.

The most conspicuous peculiarity of *Q.* plants, however, is the suppression of spines on the capsules. This may be complete, giving capsules as smooth as those of the *inermis* variety. The form of the capsule, however, is that characteristic of the variety or mutant affected, the globe mutant plants, if also *Q.*, having flattened globose fruits. Seeds from *Q.* capsules are distinctly smaller than those from normals, and their percentage of germination is less. Older seedlings also appear less vigorous than the average.

The foregoing descriptions apply to *Q.* plants raised from seed, but the condition has been known to break out spontaneously in the field, generally late in the season, on plants which have been produced by normal parents. The first symptoms are changes in the form of leaves and flowers. Purple flowers turn darker and are often mottled. As the season advances, more plants show *Q.* branches, and when normal plants have flowered and formed capsules, *Q.* plants are still flowering. Breeding experiments have been carried out, the *Q.* plants being combined with all available types of the Jimson Weed. No varietal immunity has been discovered within the species. The evidence from these experiments shows that the *Q.* infection is ordinarily carried by the female gametes and affects at least 79 per cent. of the seed produced by *Q.* parents. It can also be carried by the male gametes, but this is less common since *Q.* plants only occasionally produce pollen.

It was thought that the *Q.* complex might be due to a mosaic type of disease, such as that affecting tobacco, another member of the Solanaceae. Attempts were therefore made to transmit the infection to healthy plants by rubbing their leaves with those of *Q.* plants, but without success.

The grafting of *Q.* branches on normal stock or vice versa has invariably given infection, which is usually manifest as soon as new leaves are formed. A number of Solanaceous species were

tested by grafting with *Q.* Jimson Weeds, but none was so susceptible as the Jimson Weed itself. *Datura meteloides* was infected by grafting, but the disease was slow in making its appearance. Most of the species tested seem immune against the infection and unable to transmit the virus. The petunia is a typical example, being unable to transmit the virus through as much as 16 cm. of its stem. Experiments with tomatoes were also unsuccessful, the virus failing to pass through 3·5 cm. of the tomato stem and infect a normal Jimson graft. Both the scions of Jerusalem cherry grafted on *Q.* stock produced normal flowers with pollen and fruit, but their leaves, though normal in shape, were more or less marked with yellow blotches. Of two grafts from these infected scions on to Jimsons, one transmitted the disease. The egg-plant gave some slight evidence of susceptibility to infection, one of the two scions grafted on to *Q.* Jimsons having puckered leaves resembling those of *Datura meteloides* in the earlier stages of infection. The only other instance of susceptibility to *Q.* infection through grafting was that of *D. ceratocaula*. Of two scions grafted on to *Q.* Jimson stock, one produced a flower without pollen and two slightly abnormal buds which fell off before opening. The corollas of the latter were more or less slit. Later flowers from this plant, however, were normal.

At least one other mosaic-like disease has been found to affect *Datura stramonium*. This has been called '*Z*', and was first noticed in two adjacent plants in the field cultures of 1917. Infected plants are obviously diseased. The leaves are light in colour, mottled, somewhat eroded, and very much puckered, resembling the badly diseased leaves of beans attacked by mosaic. The leaves may be reduced to merely the midribs. The capsules are deformed, with spines reduced or absent. The buds are usually elongated, the flowers 'confused', with corollas split or malformed and numerous accessory carpels. Infection develops rapidly, and is evidently transmitted by means of contact. Attempts to communicate the disease to normal plants by rubbing them with infected leaves were mostly successful, but no extensive experiments have been carried out to discover susceptibility in other Solanaceae. It has not yet been found possible to transmit the disease to tobacco (*Nicotiana tabacum*) either by rubbing the leaves together or by grafting.

From smooth capsules of a '*Z*' plant 89 seeds were sown, giving 77 seedlings which remained normal. Experiments thus indicate that the '*Z*' disease is infectious by contact of leaves but is not carried by seed.

A number of mosaic diseases have been described in the Solanaceae. The *Q.* disease of *Datura stramonium* differs from these in being carried both by seed and pollen, and appears not to be transmitted artificially by mere contact or inoculation. The communication of infection to normal plants by grafting relates the disease to the infectious chlorosis of *Abutilon thompsoni* and other forms investigated by Baur. It differs, however, from such in that no vegetative function of the plant is obviously impaired, and also in being carried by seed.

The far-reaching morphological changes in the flowers, fruit,

and leaves of *Q.* individuals would entitle them to specific, if not generic, separation if 100 per cent. instead of only 79 per cent. of the seedlings bred true to the *Q.* complex. As the facts stand, however, there is much in the behaviour of *Q.* plants which suggests genetic phenomena. Instances in the literature are cited where the same disease appears to have been met with, but mistakenly attributed to blending or to so-called 'mosaic' inheritance.

DICKSON (B. T.). **Studies on Mosaic.**—Abs. in *Phytopath.*, xi, 4, p. 202, 1921.

The writer states that mosaic is now known in thirty genera of ten families, and mosaic-like diseases in eight genera of five families. Hyperplasia of palisade parenchyma and less chlorophyll and carbohydrate in the light areas, and generally an increase in trichomes and glandular hairs, are reported as histological symptoms of true mosaic.

GARD (M.). **Sur le dépérissement des Noyers dans quelques régions de la France.** [On the dying of Walnut-trees in some regions of France.]—*Bull. Soc. de Path. Vég. de France*, viii, 1, pp. 41–44, 1921.

One of the most serious diseases attacking walnuts is the rot described by Prillieux and Delacroix in 1878. The large roots exhibit laminated rhizomorphs, which spread into fan-shaped plates in the cortex, phloem, and cambium. As a rule the wood is destroyed only to a slight depth, though in the smaller roots all parts are attacked and decayed. The plant reacts by producing tyloses and wound-gum. One of the surest indications of the parasite is the peeling of the dead cortex at the base of the trunk, accompanied by the exudation of a blackish liquid, which solidifies when exposed to the air. At this stage, however, the tree is nearly dead.

Microscopic examination reveals the rhizomorphs embedded in the tissues, and sending feeding branches into the adjacent parts. Most authorities are agreed, with Prillieux and Delacroix, that the disease is caused by *Armillaria mellea* Vahl, and the presence of this fungus at the base of dead or dying walnuts supports this view, as also does the spread of the epidemic in rows or circles in walnut groves. Experimental inoculation from the spore or rhizomorphs has not, however, to the author's knowledge, been attempted. Experimental cultures in different media are in progress.

A second serious disease of the walnut attacks not only the roots but the branches, and is characterized by the appearance of a zone, first brown and then black, and of considerable extent, in the pericambial region. The cell-walls turn yellow, while deposits of small black granules collect along their inner surface. Certain cells rich in starch, especially in the cortex, contain a brown substance in the shape of small, variable, irregular bodies, which unite to form one or several masses, while the starch grains gradually disappear. The starch grains evidently play a part in this process, as is shown by a progressive change in their coloration and the loss of their property of being tinted by iodized water. Sometimes they seem to swell and then amalgamate to form more voluminous masses. The

cortex turns black in patches which are isolated by layers of cork, while the wood, though less affected, reveals the same discoloration in places. Tyloses and pectic gum are also formed, as in the case of rot.

The root system suffers more than the branches, at any rate at the beginning. In the older organs of both the wood undergoes less change than in the young ones. In the woody tissue there is also a transformation of the membrane of various elements, which is incompletely detached from the middle lamella. Possibly the walls take part in the process described above. Here and there are groups of bacteria, especially in the gum of the vessels. The colloidal substance engendered is insoluble in ordinary solvents, such as alcohol, ether, chloroform, benzine, and carbon bisulphide. On the contrary, hypochlorite of soda discolours and almost destroys it.

It is possible that this disease belongs to the group of the gummy degenerations ('mal nero', 'gummosis', &c.), the exact cause of which is still debated. In any case, further researches will be necessary to reveal its source. There are indications that it develops much more slowly than the disease first mentioned. Both these diseases usually occur together, sometimes one being predominant and sometimes the other. They are causing enormous damage in several districts of France.

De Wildeman (E.). **Les maladies et ennemis du palmier à huile.** [Diseases and Pests of the Oil-Palm.]—*Matières grasses* (Institut Colonial de Marseille), xiii, 153, pp. 5737–5738, 1921.

Notwithstanding the recognized fact that the African oil-palm growing in its native state in the forests of tropical Africa is less subject to attack by parasites than the highly-cultivated varieties, certain diseases do occur, and these have been largely overlooked. In May–June, 1920, an article by Maublanc and Navel appeared in *L'Agronomie coloniale* (No. 30, p. 187) describing a disease of *Elaeis* at San Thomé, which was certainly due to a Polypore (*Ganoderma applanatum* Pers.).

Miss Wakefield (*Kew Bull.*, 1920, No. 9) states that *Ganoderma lucidum* (Leys.) Pat. was reported by Farquharson in Nigeria and Swainson-Hall in the Portuguese Congo. In addition to these the following have also been found on the oil-palm in the Congo: *Ganoderma pectinatum* Kl., *pectinatum* var. *congoanum* Bres., *tumidum* Bres., *versicolor* Bres., *connatum* Pers., *fornicatum* Fr., *fulvellum* Bres., *pediforme* (Fr.) Pat., *australe* (Fr.) Pat.

Thus it is evident that even in Africa considerable damage may result from fungous diseases, and it is extremely important that all diseased material should be submitted to a competent systematic mycologist, with a view to determining the nature and extent of the danger. The greatest care should be taken to remove all decaying logs, &c., from the plantations, and to excise the diseased tissues from trees which it is possible to save (Maublanc and Navel, *loc. cit.*). The wounds should be dressed with sulphate of iron and tar, and the cavities filled with cement to increase the solidity of the trunk. If any doubt exists as to the possibility of a radical cure by those means, the trees should be destroyed, since they will otherwise only harbour the germs and disseminate them.

The method of planting in squares (suggested by Dr. Cramer of Buitenzorg) is recommended, as it facilitates the removal of worthless trees.

Insufficient attention has been paid to the ravages caused by the Oryctes, which are undoubtedly instrumental in carrying fungus-spores from diseased to healthy trees (cf. L. R. Jones, 'Problems and Progress in Plant Pathology', *Smithsonian Report*, 1914, pp. 407–419). It must be remembered also that, according to a report of Farquharson, the bud-rot of coco-nuts can be transmitted to oil-palms. The practice of 'bleeding' the latter should therefore be prohibited in all regions where bud-rot of coco-nuts is prevalent. According to Swainson-Hall, a disease very similar to bud-rot exists among oil-palms in the Portuguese Congo. Although not yet reported from the Belgian Congo or Gaboon, the disease probably exists there too, and is no doubt in part responsible for the mortality supposed to be due to excessive 'bleeding'.

KOBEL (F.). **Das Problem der Wirtswahl bei den parasitischen Pilzen.** [The Problem of Host selection by parasitic Fungi.] —*Naturw. Wochenschr.*, xxxvi, 8, pp. 113–118, 1921.

A discussion of the choice of hosts by obligate parasites. Allied fungi on allied hosts may show marked differences in specialization. Thus, *Cystopus candidus* on *Capsella* attacks various other Cruciferae, while *Peronospora parasitica* is highly specialized and seldom occurs in the same biologic form on more than one Crucifer.

Cronartium asclepiadeum has its aecidiospores on the pine, and its uredo-teleuto stage usually on *Vincetoxicum officinale*. But the latter may also be found on some fourteen other species belonging to seven Natural Orders, while several other species of the same genera are immune. It will attack, for instance, only two of nine species of *Verbena* tried, and only one of four *Impatiens*.

Uromyces trifolii has two morphologically indistinguishable forms, one of which attacks primarily *Trifolium pratense*, and in a lesser degree other *T.* species, with the exception of *T. ochroleucum*, while the other is found on *T. ochroleucum* and some other species, but never on *T. pratense*. *T. alpinum*, *arvense*, *pannonicum*, and *squarrosum* are attacked by both forms.

In considering the cause of this, several factors must be distinguished. One of the most important is the ecological one. In some cases a fungus appears to be dependent on those plants which occur naturally close to its original habitat. In 1905 Stäger found a form of ergot which attacked only *Brachypodium silvaticum* and *Milium effusum* growing in woods, and not the allied meadow species. Fischer found that *Uromyces caryophyllinus*, which forms its aecidia on *Euphorbia seguieriana* (= *E. gerardiana*), had teleutospores in Wallis (Switzerland) on both *Saponaria ocymoides* and *Tunica prolifera*, but when he brought material for inoculation from Baden he found only the latter host was readily attacked, the former responding very slightly, presumably because it does not grow in Baden. But such a connexion between specialization and natural surroundings is often absent, e. g. in *Cronartium asclepiadeum*, which attacks a number of plants quite foreign to the natural habitat of the pine.

Morphological peculiarities of plants have not, in a general sense, any close bearing on this question, though there are some exceptions. Systematic relationships also do not throw much light on it, since within even susceptible species or varieties there may be immune strains. But sometimes the systematic relationships are marked, e.g. in *Puccinia hieracii* and *Bremia Lactucae*, both of which follow closely the systematic relations of their hosts.

Chemical affinity affords a sounder clue to specialization, though there is as yet little definite work on this aspect. It is known from the work of Thöm and Thaysen (1915) that the same plant may possess different proteins, and it may be that the different hosts of a parasitic fungus have certain proteins in common. This line of work deserves to be followed up. A bibliography is appended.

KASAI (MIKIO). **On the Morphology and some cultural results of Fusarium solani (Mart.) Appel et Wollenweber, an organism which causes Dry-rot in the Irish Potato tubers.**—*Berichte des Ohara-Inst. für landwirtschaftliche Forschungen (Japan)*, i, 5, pp. 519–542, 3 pl., 1920. (Recd. Nov. 1, 1921.)

A *Fusarium* which was identified as *F. solani* was isolated from rotted tubers of *Solanum tuberosum* from the Okayama district of Japan. The *Fusarium* was found to be able to rot tubers, although slowly, when the tubers were artificially wounded and inoculated. The results of a number of cultural and morphological studies are given, together with very full spore details. The author considers that the organism very closely resembles *F. coeruleum* (Lib.) Sacc., but on the basis of shape of conidia and coloration of glucose-agar assigns it to *F. solani* (Mart.) App. and Wollenw.

CURTIS (Miss K. M.). **The Life-history and Cytology of Synchytrium endobioticum (Schilb.) Perc., the cause of Wart Disease in Potato.**—*Phil. Trans. Royal Soc. London*, Ser. B, ccx, pp. 409–478, 5 pl., 1921.

This is a very complete account of the life-history and cytology of the cause of wart disease, and forms the most important contribution to the subject as yet furnished.

The life-history of *Synchytrium endobioticum* is as follows: Zoospores are liberated from resting sporangia in the spring. After a short period of activity these spores come to rest on the surface of the host. The entire spore passes into the host cell through a small pore in the cell wall. More than one spore may enter a host cell, but these are usually separated into different daughter host cells by the cell multiplication of the host. The spore of the fungus rounds off within its host cell, and from this stage until segmentation to form sporangia begins the term prosorus is applied to the structure. The prosorus grows, as does also the host cell. The former develops a thick orange outer and a thin hyaline inner membrane. Its contents, surrounded with a delicate membrane, pass through a pore in the outer wall into the host cell. Several mitoses of the nuclei of the fungus then take place, whereupon the protoplasm segments into about five thin-walled sporangia which constitute the sorus. Further nuclear divisions (mitotic) occur,

until finally small zoospores are formed. Meanwhile the host cells have divided repeatedly, forming a tumour, and the epidermal cells in contact with an infected cell grow up to form a rosette arching over the sorus. The mature sporangia absorb water and enlarge, rupturing the host tissue, and so come to lie exposed on the surface. The motile cells escape from the sporangia. They may act either as zoospores and cause infection and the production of another sorus, or they may act as gametes and fuse in pairs. The zygote resulting from this fusion enters a host cell in much the same way that zoospores enter, but instead of forming a sorus forms a resting sporangium. This sporangium comes to lie rather deeply in the tumour because of repeated host-cell divisions above the cell containing the fungus. The resting sporangium produces a thick wall about itself, the epispore being deposited from the dead contents of the host cell. Its zoospores do not function as gametes.

The zoospores have a single long posterior cilium, attached to a blepharoplast. They may swim about for thirty to forty minutes after liberation, after which they come to rest. If not then on a host cell, they disintegrate. They seem, however, to be attracted by host tissue, and especially towards the host cells in which nuclear division is proceeding. The cilium becomes contracted, eventually forming a heavily staining globule on the zoospore. This globule is apparently thrown off. A projection meanwhile appears on the side of the nucleus towards the epidermal surface; this elongates, and reaches the surface of the zoospore next to the cell wall, and then consists of a chromatic granule connected to the nucleus by a thread of nuclear material. This projection, doubtless covered by a layer of cytoplasm, which, however, is too thin to be visible, then pierces the cell wall and enters the host cell, and the cytoplasm and nucleus of the zoospore follow through the pore. The nucleus is much drawn out in the process of entering, but once within, the nucleus and prosorus round up. The pore through which the zoospore entered is not evident after penetration has occurred. Zoospores derived from the same sporangium apparently will not act as gametes and fuse, but those from different sporangia (even of the same sorus) seem to be mutually attracted and fuse. No cell wall appears to be formed around the zoospore after it comes to rest, only plasmatic membranes being present from the beginning until the prosorus or resting sporangium has reached a fairly advanced stage of development.

The author presents many cytological details in addition to those mentioned above. While the nuclear divisions are mitotic in the developing sorus and non-resting sporangium (although accompanied by nucleolar discharges of globules, the production of strands, &c.), the nuclei after fusion, i. e. in the formation of zoospores in the resting sporangia, divide amitotically. Reduction is considered to come about by extrusion into the cytoplasm of granules of chromatin.

Persistence of the organism in the soil may be explained perhaps either by resting sporangia remaining ungerminated, by the infection of other host plants, or by a saprophytic mode of life.

The fact that sori are developed in the spring and resting sporangia in late summer or autumn is considered to be dependent

not upon temperature, but upon moisture supply. Only matured zoospores, developed while the sporangia remained comparatively dry, were found to fuse, and from zygotes only are resting sporangia produced.

The author discards the generic name *Chrysophlyctis* for this fungus, and does not consider that *Pycnochytrium* is a genus sufficiently distinct from *Synchytrium*.

A bibliography is appended, and the paper is fully illustrated.

JENNISON (H. M.). **Bacillus atrosepticus van Hall, the Cause of the Blackleg Disease of Irish Potatoes.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

The writer concludes from an exhaustive study of the comparative morphology and physiology of the parasites that *Bacillus atrosepticus* van Hall (1902), *B. phytophthorus* Appel (1903), *B. solanisaprus* Harrison (1906), and *B. melanogenus* Peth. and Murphy (1910) are identical, and agrees with Morse that *B. atrosepticus* should stand. The group number is given as 221·1113033.

HEALD (F. D.). **The Skin Spot (Oospora pustulans) of the Irish Potato.**—Abs. in *Phytopath.*, xi, 2, p. 104, 1921.

This disease was found on 95 per cent. of the tubers in several car-loads of Gold Coin potatoes shipped to Spokane, Washington, from British Columbia. Affected tubers showed very poor keeping qualities.

YOUNG (H. C.) & BENNETT (C. W.). **Studies in Parasitism in the Fusarium Group.**—Abs. in *Phytopath.*, xi, 1, p. 56, 1921.

Wilting of potato plants may be produced by a water solution of an alcoholic precipitate derived from a 28-day culture of *Fusarium oxysporum* in Richard's solution. Hence the fungus acts not by plugging the vessels but by the production of substances, the exact nature of which is being investigated.

MARTIN (W. H.). **A Comparison of Inoculated and Uninoculated Sulfur for the Control of Potato Scab.**—*Soil Science*, xi, 1, pp. 75–84, 1 pl., 3 figs., 1921.

A number of experiments conducted by the author and here described in considerable detail led to the following conclusions:

The addition of sulphur to soil usually leads to an increase in soil acidity due largely to the oxidation of the sulphur by sulphofying micro-organisms. Where these organisms are absent it is necessary to supply them.

On the soils used for these experiments the use of sulphur inoculated with sulphofying organisms gave better control of scab than similar amounts of uninoculated sulphur. In addition to the difference in control, smaller quantities of inoculated sulphur produce the required results.

Hydrogen-ion exponent values of soil samples taken from plots treated with inoculated and uninoculated sulphur respectively were considerably lower than corresponding exponent values of soil samples taken from check plots. In most instances this increase in acidity was accompanied by a corresponding decrease in the number of scabby tubers.

McKay (M. B.). **Transmission of some Wilt Diseases in Seed Potatoes.**—*Journ. Agric. Res.*, xxi, 11, pp. 821–848, 8 figs., 3 pl., 1921.

Verticillium albo-atrum is more important than *Fusarium oxysporum* as a cause of wilt of potato plants in western Oregon. Isolations made from 12,136 tubers yielded *V. albo-atrum* in 17·3 per cent. of the cases, and 30·7 per cent. of the tubers showing browned vascular tissue at the stem end gave this fungus. It may be present in tubers not showing discoloration, an average of 6·6 per cent. of the tubers that yielded *V. albo-atrum* being free from discoloration. *Fusarium oxysporum* (which also causes wilt) was present in 2·4 per cent. of all the tubers cultured. *F. radicicola*, which is not known to cause wilt but discolours the tubers, was isolated from 4·2 per cent. In general, *Fusarium oxysporum* produced the heaviest discoloration, *F. radicicola* next heaviest, and *Verticillium* the least heavy discoloration of the three fungi; but identification of the pathogen cannot be made with certainty from an examination of the vascular discoloration. In many cases no organisms were obtained from tubers showing discoloration. Other Fusaria and miscellaneous fungi may also occur in the stem ends of tubers. The longer the potatoes are kept in storage, the greater the number of tubers giving organisms in culture. *V. albo-atrum* occurred somewhat more extensively in small potatoes than in those of medium size. The presence of *F. oxysporum* and *F. radicicola* shows no particular correlation with the size of the tubers. Sometimes more than one organism is present in the discoloured tubers.

From 30 to 50 per cent. of the tubers grown from seed potatoes infected with *Verticillium* were invaded by the same organism. *Fusarium radicicola* and *Fusarium oxysporum* were transmitted to only a slight extent from seed potatoes to yields, and are probably present in the soils.

It was found that little reliance could be placed upon the practice of discarding the stem end portions of potatoes which showed vascular discoloration, since practically the same amount of disease was obtained from planting eye ends as from planting stem ends of the infected tubers.

Potato plants affected with *Verticillium albo-atrum* yield 30 to 50 per cent. less than unaffected plants, and the disease causes appreciable losses each year in western Oregon. Fusaria producing wilt cause little loss in this region.

Tisdale (W. H.) & Jenkins (I. M.). **Straighthead of Rice and its Control.**—*U.S. Dept. of Agric. Farmers' Bulletin*, 1212, 16 pp., 7 figs., 1921.

Straighthead, a name commonly given to rice heads (panicles) which are so nearly sterile that they remain erect when mature, is one of the most destructive diseases of irrigated rice in the Southern States. A number of other forms of sterility may be confused with it, namely:

1. Alkali Injury, due to an abundance of alkali in the soil which weakens the plants and gives them a stunted and rusty

appearance. Some of them fail to produce seed after heading, but these do not remain green as do plants with typical straighthead.

2. Drought Injury, developed when the plants are heading; their rapid dying and blasted appearance distinguish this trouble.

3. Nitre Spots, a local (Californian) condition causing green plants to be seen at harvest time. They are sterile and straight, but none of the typical straighthead symptoms could be detected. Experimental dosing with nitrogen in sufficient quantities to kill most of the plants failed to produce sterility in those that headed.

4. Dry, hot winds are said to cause considerable sterility of rice in California. The heads have a blasted appearance as if they had been scorched by fire.

5. Poor, grassy land causes sterility, especially when there is not sufficient water to kill the weeds and grass. The glumes in these cases are likely to be stained by invading fungi. The other typical straighthead symptoms are absent and this form of injury is not common.

6. Rotten Neck *(Piricularia)*, a fungous disease which may kill rice heads sufficiently early to prevent their filling normally. The frequent breaking of the heads and the brown discoloration caused by the fungus prevent their being mistaken for straighthead.

Investigations have shown that straighthead is caused by certain unfavourable soil conditions and not by a parasitic organism, which all attempts have failed to find. The disorder is chiefly found either on virgin soil or on land on which non-irrigated crops (notably corn and cow-peas) have been grown for a number of years preceding the rice crop. Decaying organic matter aids the disease, and it has been found that where corn is grown on ridges—as is the case in the Southern States—rice plants in the corn rows are normal while those in the furrows (where the old corn and pea plants are generally thrown) suffer from straighthead. Want of aeration in the soil, partly due to excessive and premature irrigation, appears to be an important contributory cause. Loose soil, which when irrigated becomes soft clinging mud, is not favourable to the growth of the plants as the air is pressed out by the water.

The symptoms are not easily detected until the plants have headed, but even before this stage of the development is reached there are certain characteristic peculiarities: (*a*) the leaves of the diseased plants appear darker green and stand more erect than the leaves of normal plants; (*b*) the sheaths adhere closely to the stem and are hard to remove even when the plants are dry; (*c*) the heads emerge slowly and do not extend as far above the top sheaths as do normal heads: plants affected severely may even fail to head; (*d*) when the glumes start to develop, aborted glumes are the most noticeable symptom; (*e*) most of the flowers in diseased plants never open, and no indication of seed development can be seen, while others open normally but fail to produce kernels; (*f*) straighthead plants remain green (the heads noticeably so) after normal plants of the same age are mature; (*g*) diseased plants show strikingly abnormal root systems: they will be found to have a large number of coarse, or water, roots, and these only sparingly

branched, while the normal plant possesses only a few of these coarse roots and will be branched abundantly, with a large number of secondary roots and root-hairs. These root characteristics of diseased plants are useful in detecting the disease in its early stages and thus making it possible to aerate the soil in time to prevent a severe outbreak of straighthead.

According to the authors, it has been proved conclusively that aeration of the soil, if properly carried out, will prevent straighthead. It is recommended to irrigate for about six weeks, commencing about ten days after the plants emerge, or when they are six to eight inches high. If symptoms of the disease are seen then, drain the land and leave from two to three weeks. When the plants begin to turn yellow and show signs of withering, apply water again and retain it for the remainder of the season.

B(OBILIOFF ?) (W.). **Over het uitdunnen en het optreden van bruine binnenbast-ziekte bij Hevea.** [Thinning-out and the occurrence of brown bast disease in *Hevea*.]—*Teysmannia*, xxxii, 3, pp. 141–142, 1921.

The writer discusses the results obtained by Harmsen ('Uitdunnen volgens productie-gegevens en het optreden van bruine binnenbastziekte', *Nederl. Ind. Rubbertijdschr.*, v, p. 745, 1921), which tend to show that the more productive trees of *Hevea brasiliensis* are most subject to brown bast. Harmsen found that if he divided the trees into five classes according to the daily yield of latex (Class I, 1–20 grammes; Class II, 20–30 gm.; Class III, 30–40 gm.; Class IV, 40–50 gm.; Class V, more than 50 gm.), the amount of brown bast developed in these trees was as follows: Class I, 13·9 per cent.; Class II, 17·8 per cent.; Class III, 23 per cent.; Class IV, 25·7 per cent.; Class V, 31 per cent. From this it is evident that in selecting trees for thinning, other circumstances than mere yield must be taken into account, and especially liability to brown bast. The writer thinks that in thinning-out, the number of rows of latex vessels in the bast should be taken into consideration. The trees would then be removed in which the structure bears no relation to production, i.e. those *presumably* susceptible to brown bast. Further investigations are necessary to confirm the reliability of this theory.

LA RUE (C. D.). **Lightning Injury to Hevea brasiliensis.**—*Mycologia*, xiii, 2, p. 125, 1921.

Lightning injury to the Pará rubber tree is seldom shown in the sudden tearing or breaking of the branches. As a rule, a single small branch at the top of the tree dies first, the trunk gradually becoming affected and dying back until the root is reached. This progressive death of the tissues suggests the invasion of the tree by a destructive organism. The injury has been attributed to *Diplodia*, and the organism in question was named *Diplodia rapax* Massee. The author's cultures showed that *Diplodia* was the only organism constantly present, but it can only be regarded as secondary, and not the cause of the death of the tree. The injury is most marked in the cambium region, the tissues of which turn deep purple and decay rapidly. This discoloration is considered by

the author to be a distinguishing characteristic of this type of injury. Trees surrounding the affected tree often exhibit the injury in a lesser degree and at a later stage, thus suggesting the spread of an organism from one tree to another.

WURTH (TH.). **Verslag omtrent de Werkzaamheden van het Proefstat. Malang over 1920.** [Report of the Work of the Malang Experiment Station during 1920.]—*Meded. van het Proefstat. Malang*, 34, 17 pp., 1921.

The following diseases of rubber were prevalent:

Leaf-fall due to attack by *Phytophthora*, which occurred at the period of leaf-change (ordinarily dry but characterized on this occasion by heavy rain) and led in some cases to the death of the new leaves; stripe-canker; *Oidium* (general, but not a serious danger); and Djamoer oepas (*Corticium salmonicolor*), which was worse than usual.

Pure cultures of the *Phytophthora* causing leaf-fall were obtained, and inoculation experiments showed that the parasite in question has more in common with *Phytophthora faberi*, the agent of patch-canker and cacao-canker, than with *P. meadii*, which causes stripe-canker and fruit-rot.

BLOMMENDAAL (N.). **Het optreden van witte vlekken op crepe.** [The occurrence of white spots on crepe rubber.]—*Meded. van het Algemeen Proefstat. der A. V. R. O. S.*, Rubberserie 33, 6 pp., 1 fig., 1921.

Crepe rubber has been found to be attacked by a bacterium which produces white spots, sometimes of considerable extent. The organism, one of the slime-forming Micrococcaceae, is described. It requires oxygen and moisture for its development, and therefore grows best on material exposed to the air (damp crepe, lumps, and scrap). It has also been isolated from latex and from the coagulum before rolling. The white slimy lumps found frequently on the cement floors of rubber factories contain large numbers of the bacterium in question, which is also present in the Shanghai jars used for storing the material, and these are probably the usual source of infection. Latex exposed to the air overnight developed two distinct colonies, white and yellow, of which cultures were taken. After further exposure to the air the yellow colonies (which the author thinks may possibly be the cause of 'rustiness' in sheet rubber) became predominant. The white colonies appeared to be identical with those already isolated from the spots and the floor-slime, and were found to be capable, when inoculated in pure culture on crepe, of reproducing the spots. To avoid infection the coagulum should be kept entirely under water until ready for use. Damp crepe should be dried as quickly as possible, and the factory, Shanghai jars, &c., must be kept scrupulously clean.

KNIEP (H.). **Urocystis anemones (Pers.) Winter.**—*Zeitschr. für Botanik*, xiii, 5, pp. 289–311, 1 pl., 1921.

Urocystis anemones produces on germination a short promycelium tube which throws out at its tip three or four branches forming a whorl. The diploid nucleus of the smut spore divides into

four, very probably with reduction of the number of chromosomes. These four nuclei pass one into each of the whorl branches, or, in the case where only three whorl branches exist (the more frequent case), a nucleus passes into each of them, and the fourth remains in the whorl stem. The branches are then separated from the original promycelium tube by septa, and form separate cells. Then appear the first signs of conjugation; conjugation canals, having the shape of a horseshoe, are formed joining the bases of each pair of whorl-branches, or, in the case of three branches only, between one pair of branches, and between the third branch and the whorl stem. Through these canals one of the nuclei migrates over to its partner, forming thus two pairs of nuclei; it is noteworthy that the nucleus from the stem passes always into its conjugated branch, the reverse never having been observed. The branches in which the paired nuclei occur begin then to elongate considerably, while the cells from which the nuclei have migrated are emptied and cut off by a septum; the former grow rapidly, the plasma pushing continually forwards and being from time to time separated at its base by a septum from the empty part, and form two long, articulated and mostly empty threads, each carrying a double-nucleus cell at its tip.

In water culture development soon ceases owing to lack of food. In adequate dilute nutrient solutions it progresses farther, and after some weeks thick flakes consisting of richly branched and entangled hyphae can be distinguished. In these also most of the cells are devoid of protoplasm. Spores taken from ripe infection-boils ready to burst were sown in test-tubes with about 5 c.c. nutrient solution, and also streaked on gelatine plates (3 per cent. malt extract, 10 per cent. gelatine). The latter was unsatisfactory owing to too high concentration. In a 0·1 per cent. malt extract solution germination was far better, though it was still several weeks before the mycelium was visible macroscopically in test-tubes sown with a few spores. Then small, light-brown flakes were seen which increased to about the size of a lentil. A culture started on October 22, 1917, and kept in a warm room, showed on December 5 the presence of smut spores, to whose formation the brown colour was chiefly due though the vegetative hyphae were also partly coloured brown. With the cells containing protoplasm, many others that were empty were found. The masses are formed by the copious branching and entanglement of the hyphae. Many of the cells containing protoplasm are swollen and often joined in rows like a string of pearls. Such swollen cells are mostly divided by several septa and give rise to a complex of primary and companion spores. As under natural conditions on the host primary spores are at times found alone without companion cells, so also in the cultures isolated primary spores were observed. Groups of empty companion cells were also sometimes seen without primary spores. The ripe spores produced in culture were completely identical with those from the host. It has thus been proved that it is possible without difficulty to grow *Urocystis anemones* from smut spore to smut spore outside the host under conditions of saprophytic nutrition, a step not hitherto completely accomplished for any other smut fungus. Tests with 0·1 per cent. malt extract on *Ustilago tritici*

failed to give true smut spores, so the medium is not of universal application. Further examination of the best concentration to use with *Urocystis anemones* indicated that 0·5 per cent. malt extract gave the optimum conditions of culture.

The phenomena observed during the development of *Urocystis anemones* make it probable that the four nuclei which issue from the diploid smut-spore nucleus and distribute themselves among the branches of the promycelium differ the one from the other in each pair; that there exists a physiological sexual differentiation caused by the reduction division, as has been experimentally proved to be the case in the anther-smuts and with *Ustilago scabiosae* (Kniep, 1919), though with *Urocystis anemones* a similar experimental proof cannot be made, because the whorl-branches do not fall off and are not capable of yeast-like budding. Such a complicated conjugation mechanism would evidently be quite unnecessary if it were indifferent which of the four nuclei unite together in pairs. The isolation of the four nuclei in four closed cells and the ensuing formation of conjugation canals have apparently the purpose of preventing the meeting of sexually alike nuclei, as might happen if the nuclei were allowed to group together without this mechanism. It is suggested that each nucleus bestows on the cell to which it belongs the corresponding sexual character, and that, owing to this, the cells of different sexes are stimulated to put out towards each other the short processes which later fuse into the horseshoe-shaped conjugation canals.

The author considers *Urocystis anemones* to be an aggregate species, and to this is to be traced the differences in germination observed by other workers. A remarkable fact is that forms originating from different host plants differ in that the spores of some of them require a period of rest before germinating, and others do not. This recalls the behaviour of some seasonally dimorphous Phanerogams, and may be partially explained by the ecologic habits of the hosts.

DASTUR (J. F.). **Cytology of Tilletia tritici (Bjerk.) Wint.**—*Ann. of Botany*, xxxv, 139, pp. 399–407, 1 pl., 1921.

The results of investigations carried out by the author are summarized as follows:

The spore, on germination, produces a single-celled promycelium, into which the undivided spore-nucleus passes. The divisions of this nucleus do not take place at any fixed stage in the development of the promycelium, and the number of daughter nuclei, as also of sporidia, is variable, but generally eight. Each sporidium usually receives a single nucleus from the promycelium, and the sporidia conjugate in pairs, either while still fixed or after they fall off. As a result the nucleus and part or the whole of the cytoplasm of one sporidium pass into the other, which then germinates and produces a secondary sporidium. The latter is shorter, broader, and more sickle-shaped than the primary one. It is usually uninucleate, but at times binucleate. In a few cases fusion of the conjugate nuclei has been observed in the secondary sporidium. More often a division of a single non-conjugate nucleus has been seen to be the cause of the two nuclei at times found in the

secondary sporidium. Tertiary sporidia, when found, are uninucleate, while the infective hyphae and also the hyphae of the later-formed mycelium in wheat seedlings are uninucleate or multinucleate, never regularly binucleate.

Seedlings a day old were inoculated with cultures from germinated spores, incubated at 50° C. and fixed in Fleming's weak solution from time to time. From sections of these the penetration process was followed.

The infecting hypha, as a rule, enters the first or outermost leaf-sheath between the epidermal cells, by pushing aside their adjoining walls, these being sometimes ruptured in the process. Direct entry of the germ-tube into the lumen of the epidermal cells takes place very rarely.

DEERR (NOEL). **Cane Sugar.** *Second (revised and enlarged) Edition*, viii + 644 pp., 30 pl., of which 12 are coloured, and numerous illustrations in text. London, Norman Rodger, 1921.

The new edition of this well-known text-book has been completely rewritten. The first four chapters contain a description of the macro- and microscopic characters of the sugar-cane plant, its chemical composition, range of distribution, and varieties. These are followed by an account of the agriculture of the cane. The remaining chapters, comprising more than two-thirds of the whole, deal with the manufacturing processes and sugar-house chemistry.

Chapter ix contains an account of the pests and diseases of the cane. The diseases due to fungi and bacteria are fully described and for the most part illustrated. In each case there is a Latin diagnosis of the parasite with a description of the symptoms, distribution, and severity of the disease.

Of diseases, the cause of which is not definitely known, the chief are sereh, mosaic or yellow stripe, chlorosis, top rot, and the leaf-splitting disease. There is, the author points out, still much confusion regarding what is called 'rind-disease', especially as to whether *Melanconium sacchari* is to be looked upon as parasitic or strictly saprophytic. The author quotes several apparently contradictory observations, concluding that the mass of evidence points to the non-parasitic nature of the fungus, though it may perhaps under certain conditions become an active parasite. The chapter terminates with a discussion on the practical control of cane diseases.

EASTERBY (H. T.). **Twentieth Annual Report of the Bureau of Sugar Experiment Stations, Queensland, to the end of October, 1920.** 1921.

Of interest is the following from the report of work at the Northern Experiment Station at South Johnstone (Innisfail):

In 1913, when it was thought that some varieties, including the valuable *Badila*, were showing signs of deteriorating, a number of them were sent up to the Kairi State Experiment Station to see if a change to a higher altitude would bring about a rejuvenescence. After six years, during which none of them showed a trace of disease, they were brought down again during the current year

and planted at Innisfail. All of them showed a markedly better growth than canes that had not been sent to the hills.

THOM (C.) & CHURCH (MARGARET B.). **Aspergillus flavus, A. oryzae, and associated species.**—*Amer. Journ. of Bot.*, viii, 2, pp. 103–126, 1921.

Some types of *Aspergillus* are so closely identified with the fermented food products of the Orient that a comparative study to determine their significance in the fermentation processes is called for. These organisms are not only found in the oriental fermentation industries but have a world-wide extension, and their numerous strains align themselves into groups of closely related forms which the authors, for convenience, have classified under three series names: *Aspergillus flavus-oryzae*, *A. wentii*, and *A. tamari*.

Between *A. oryzae* (Ahlb.) Cohn, the diastatic power of which has brought into being the saké industry of Japan, and *A. flavus*, there exists a whole series of forms, which, morphologically, bridge the gap. In fermenting samples obtained from China the dominant organism possesses characteristics that are to be referred to *A. flavus* in the sense of Brefeld and Wehmer rather than to *A. oryzae* (Ahlb.) Cohn, and the same obtains in cultures from certain of the koji products distributed under the patents of Takamine. All these forms have, however, one chief characteristic feature in common, and that is the structure of the walls of the conidiophore stalks and conidia, which are pitted. The pits on the ripe conidia are elliptical instead of circular, thus giving the appearance of being areolate. It is to be noted that the cell walls, when examined with a low magnification, are often recorded as rough or spinulose.

Colonies grow best in starch- and sugar-containing media. Some strains fruit at temperatures up to 50° C. Spores survive heating to 57·2° C. for thirty minutes and dry heat at 110° C. for thirty minutes. All forms show mixtures of yellow and green colour when grown in Czapek's solution agar, but some strains lose this more or less rapidly, and a tendency towards floccosity is at times observed.

Amongst the intermediate strains linking up *A. flavus* and *A. oryzae* the following are named and described: *A. oryzae* var. *basidiferens* Costantin and Lucet; *A. pseudoflavus* Saito; *A. microvirido-citrinus* Cost. and Luc.; *A. gymnosardae* Yukawa; *A. parasiticus* Speare; *A. effusus* Tiraboschi.

The stalk throughout the genus *Aspergillus* originates as a mycelial cell transformed into a spore-producing organ. The cell broadens, its walls thicken, and from it, and approximately perpendicular to its course, arises the stalk, the original cell remaining in the hypha as a kind of foot. Usually the stalk in its growth becomes many times the size of its foot, both in breadth and length, and in *A. effusus* the foot-cell, which is often very long and branching, connects with other foot-cells and forms a trailing, fertile hypha from which the stalks arise as short branches. This strain of *Aspergillus* was isolated from spoiled corn products.

In the chapter devoted to the nomenclature of subsidiary types of the series, a short historical analysis of some of the more prominent forms is given. The authors suggest that one or other

of the *A. herbariorum-repens-amstelodami* series in the sense of Mangin was the basis of Link's description of his *A. flavus*, though it is not now possible to be sure what Link had.

Certain strains of this group have resulted in lesions and death when injected into animals, and they have also been found in connexion with infection in the human ear, but active pathogenicity has not been proved.

After careful and prolonged study of the subject the authors arrive at the conclusion that the species described by Brefeld and Wehmer and believed by them to be *A. flavus* Link is the type of a cosmopolitan organism, of which *A. oryzae*, *A. parasiticus*, and *A. effusus* are closely related, but morphologically recognizable, varieties or species.

Going on to *Aspergillus wentii* Wehmer and related forms, the authors found the species to differ from Wehmer's characterization in the quite general presence of both primary and secondary sterigmata. Perithecia were not found and sclerotia were limited to more or less undefined masses of thick-walled cells, occurring occasionally, not uniformly. All strains tested find their cultural optimum below 37° C.; they liquefy gelatine, both with and without sugar.

In the series *A. wentii* typical test-tube cultures produce a mass of sterile mycelium above the colony, which overgrowth becomes more prominent on potato plugs. There are, however, strains that possess this characteristic only partially or not at all, and the authors justify their inclusion in the series by reference to other common structural characters. The forms of this series have a wide range of substrata, including organic materials and soil.

A. tamari Kita and its allies, which form the third series under discussion, are distinguished from the other brown species by the absence of true green in colour; by stalks prominently pitted, especially towards the apex; and by conidia tuberculate at the distal end in the chain, rough, showing firm, fairly thick, and not pitted inner walls, and thin vesicular outer walls fitting rather loosely over masses of branching, more or less irregularly arranged bars of yellow-brown substance. In size of colony, habit, and appearance apart from colour, which is similar to *A. wentii*, these forms resemble *A. flavus*, while the markings of their conidia suggest *A. niger*. Their distribution is world-wide in forage and feeding stuffs, oriental soy fermentations, and in soil.

To illustrate the fallacy of overstressing the significance of measurements in miscellaneous cultures, instances are given of the difference in size of vesicles, primary sterigmata, and conidia obtained from cultures grown on different media. A strain of *A. tamari* when grown upon Czapek's solution agar showed vesicles about 35 μ in diameter, primary sterigmata 8 to 14 by 3 to 5 μ, and conidia 5 to 6 μ in long axis, while the respective measurements for the same strain grown on unsterilized, clean corn for two weeks were 100 μ, 25 to 35 by 5 to 9 μ, and 8 to 9 μ. Transferred back to Czapek's solution agar, the original measurements were once more obtained. The variations in environment seemed to affect the secondary sterigmata much less than the primary ones. These experiments emphasize the necessity of using a standard medium

as the basis of comparative studies of saprophytic organisms, for even in the most carefully standardized culture work a certain elasticity in the measurements is required.

Variations in colour help to separate different strains of the *A. tamari* series, but the same culture will exhibit different colours according to age or on exposure to acid or alkali. Whilst these are less marked than in members of the *A. flavus* group, it is clearly established that the differences in colour are due to variation in the reaction induced by the metabolic activity of the organism. These differences vary with the composition of the medium, and with the characters of the race or strain studied, but clearly indicate close relationship among the forms. Amongst the special forms studied is *A. citrisporus* v. Höhnel, which was got from caterpillar excrement, while another form, found in redland soil in Georgia, is described under the name of *A. terricola* var. *americana* Marchal n. var. These forms are readily separable in culture.

A key to the species described from culture, and a bibliography with critical notes, are appended. The latter covers many species that may belong to the groups here described, but of which material was not available.

GROVE (W. B.). **Mycological Notes. V.**—*Journ. of Bot.*, lix, 697, pp. 13–17, 2 figs., 1921.

Describes *Boydia insculpta* (Oud.) Grove comb. nov., a parasite of holly (*Ilex aquifolium* var. *hendersonii*) with very remarkable and unusual spores, and gives the previous history and synonyms of this fungus. Records the very rare British rust, *Puccinia peucedani-parisiensis* (D.C.) Lindr., on *Peucedanum officinale*. Determines as *Phomopsis abietina* (Hartig) Grove (*Phomopsis pithya* Lind) a parasite of *Pseudotsuga douglasii*, which also occurs on dead *Pinus sylvestris*, from Scotland. It is suggested that the last fungus may be the same as *Fusicoccum abietinium* Pril. and Del., *Dothiorella pithya* Pril. and Del., and possibly even *Sclerophoma pithya*, these being merely forms of the one species.

PETCH (T.). **Red Rust on Tea.**—*Tropical Agriculturist*, lvii, 3, pp. 188–192, 1921.

In describing the symptoms of this well-known disease the author points out that it is necessary to distinguish between leaf variegation due to non-parasitic chlorosis and that due to red rust. In the variegated leaves of bushes attacked by red rust, the white areas usually shade off into the green, whilst in the case of chlorosis the demarcation is generally fairly well defined. The attack on pruned branches of diseased plants is also described. As a rule, these affected branches do not produce new shoots but die back.

It has usually been supposed that there is only one species of *Cephaleuros* on tea, appearing sometimes in an epiphytic (superficial and harmless) form, sometimes in a parasitic form, but the author's studies seem to point to the fact that each form is due to a distinct species, namely, *C. mycoidea* and *C. parasitica* respectively. It is the last named which is so destructive, particularly when it attacks the stems. The effect on the young green stems may be, as in the case of the leaves, to cause watery green areas to appear, which

subsequently blacken and produce clusters of red hairs; generally speaking, however, the first evident sign is a premature hardening of the twigs with the dead epidermis showing in grey patches. Whether the latter has been killed by penetration or by simple contact, is not certain, but it is probable that in the second eventuality the algal filaments enter the tissues later. On the older bark the spores lodge in the minute cracks, where they germinate and penetrate to the living tissues. The effect extends beyond the limits of penetration, a layer of dead cells existing between the algal and the living host tissues.

Red rust is a weak parasite, and vigorous plants have been found to be highly resistant. Usually, the cause of weakness in the plants resides in the soil, and improvement in the soil conditions is followed by a diminution in the disease. The recent increase in its severity in Ceylon is attributed by the author to the shortage of manures which occurred during the war, especially of potash fertilizers. This chemical favours the development of strong wood, which is an important point as red rust is only really serious when it attacks the stems.

With regard to spraying, this offers some difficulties, as it is scarcely practicable on unpruned tea, and also as the velvety patches are hard to wet. Hence it is best to use Bordeaux mixture on pruned bushes before the red hairs develop. Severely attacked bushes should always be sprayed after pruning.

FROMME (F. D.). **Wildfire and Angular Spot.**—*Rhodesia Agric. Journ.*, xviii, 4, pp. 411-414, 1921.

A verbatim report of a circular issued by the Plant Pathologist of the Virginia Agricultural and Mechanical College and Polytechnic Institute and the U.S.A. Department of Agriculture, co-operating. In a foreword the Tobacco Expert of the Board of Agriculture, H. W. Taylor, states that both the diseases in question now occur in Rhodesia, and that they have no doubt been imported with tobacco-seed from the U.S.A.

Angular spot has been very prevalent during the past two seasons and has caused severe loss. The Rhodesian Department of Agriculture is prepared to treat tobacco-seed free for farmers in Southern Rhodesia, and it is hoped by this means, and by the precautions advised in the American work, that the loss will be greatly reduced next season.

JOHNSON (J.). **Inheritance of disease resistance to Thielavia basicola.**—Abs. in *Phytopath.*, xi, 1, p. 49, 1921.

When varieties of tobacco, such as Little Dutch, which are resistant to root-rot are crossed with susceptible varieties, such as White Burley, the first generation is intermediate as regards resistance. The second generation gives individuals of all grades of resistance, from those even more resistant than the resistant parent to those as susceptible as the susceptible parent. Selected individuals in the third generation may continue to vary, while others appear to breed true for the resistant character. Susceptibility is apparently a recessive character. No simple Mendelian

ratio was found, but the inheritance may be best explained by the multiple-factor hypothesis.

FROMME (F. D.) & WINGARD (S. A.). **Treatment of Tobacco-seed and suggested programme for control of Wildfire and Angular Spot.**—Abs. in *Phytopath.*, xi, 1, p. 48–49, 1921.

Treatment of tobacco-seed for fifteen minutes in 2 per cent. formaldehyde causes no injury to germination when followed by thorough washing and drying, and completely frees the seed from the wildfire and angular spot organisms.

BEWLEY (W. F.) & BUDDIN (W.). **On the Fungus Flora of glass-house water supplies in relation to Plant Diseases.**—*Annals of Appl. Biol.*, viii, 1, pp. 10–19, 1921.

Little attention has heretofore been given to the danger of introducing disease organisms with the water supplied to plants. The writer's attention was drawn to this danger by finding *Phytophthora cryptogea* Pethybr. and *P. parasitica* Dastur in the water supplied to tomato plants.

Samples of water were obtained by means of a filter made of two layers of wire netting, cupped in the centre, and containing cotton-wool between the two pieces of netting. The filter was sterilized, and a considerable quantity of the water was allowed to pass through it. The cotton-wool was then removed and shaken in physiological salt solution, and cultures made on various agars.

From water from various sources (wells, tanks, brooks, ponds) the following organisms were obtained. The number after each fungus indicates the number of samples which contained the organism in question out of forty-one samples tested:

Botrytis cinerea, 17	*Phytophthora cryptogea*, 6
Cladosporium cucumerinum, 1	*P. parasitica*, 6
C. fulvum, 9	*Phoma* sp., 28
C. herbarum, 34	*Rhizoctonia solani*, 11
Fusarium sp., 25	*Rhizopus nigricans*, 23
Macrosporium solani, 13	*Verticillium albo-atrum*, 13

Bacillus lathyri was also found in three samples.

The Water Company's supply and deep artesian wells gave the purest water; brooks and ponds the most contaminated. Certain of the waters were found to be moderately good culture media for the fungi.

Mercuric chloride was found to be the best of the chemicals tried for the purification of the water, varying amounts from one part of $HgCl_2$ to 200,000 parts water to 1 to 5,000 being sufficient to kill the spores and mycelium of the fungi tested. Fifty to seventy degrees C. for one minute was the temperature required to kill the mycelium and 'summer' spores of these fungi.

HAMBLIN (C. O.). **Spotted Wilt of Tomatoes.**—*Agric. Gaz. of New South Wales*, xxxii, 1, p. 50, 1921.

The causal organism of this disease has so far not been discovered, in spite of prolonged research. Inoculations of healthy plants with

bacteria isolated from diseased tissues had negative results; in fact, though the field indications point to the infectious nature of the disease, all attempts at its transmission from diseased to healthy plants have so far met with failure, even actual contact not bringing about infection.

Two insects (*Nezara viridula* and the common green aphis) were suspected transmitters, but tests have totally disproved their connexion with the disease. The possibility of transmission by seed seems to have been discounted by examining carefully data collected from the fields.

Not one of the various specifics recommended seems to have been successful in checking the disease.

HAMBLIN (C. O.). **Overwintering of Spotted Wilt of Tomatoes.**—*Agric. Gaz. of New South Wales*, xxxii, 8, p. 547, 1921.

According to observations carried out in a suburban garden, the disease winters in the old plants. The exact method of its transmission from plant to plant is unknown; growers would do well, however, to incinerate all old vines before commencing to raise early seedlings.

SOUTH (F. W.). **An important Root Disease on Borneo Camphor.**—*Agric. Bull. Fed. Malay States*, ix, 1, pp. 34–36, 1921.

In December, 1920, two-year-old seedlings of Borneo camphor (*Dryobalanops aromatica* Gaertn.) were found killed by a root disease due to *Rosellinia bunodes* (B. and Br.) Sacc. The tree is being extended and encouraged by the Forest Department, F.M.S., on account of its valuable timber.

This fungus has been reported from India and the West Indies as an important parasite attacking a number of plants belonging to widely different families. It has been recorded on coffee in Southern India and causes stump-rot of pepper in Mysore, where it attacks also *Litsea angustifolia*, *L. Wightiana*, *Schleichera trijuga*, *Holigarna longifolia*, and *Grevillea robusta*. In the West Indies it attacks cacao, limes, Castilloa rubber, camphor (probably *Cinnamomum camphora*), arrowroot, and a number of forest trees. In Porto Rico it probably occurs also on coffee. The species named *Rosellinia echinata* Massee, which attacks the roots of *Ficus dubia*, Dracaenas, rattans, Dieffenbachias, and of various shrubs and even herbs growing together under the *Ficus*, in the Singapore Botanic Garden, is now generally held to be identical with *Rosellinia bunodes*.

The fungus is probably indigenous in the Malay Peninsula, since the seedlings on which it was found came from a Forest Reserve devoted to the cultivation of an indigenous tree by methods which do not involve the introduction of planting material from outside. But it seems to be of limited distribution, and has not been found on Pará rubber, although the very wide range of its various hosts admits of the possibility of its attacking *Hevea* and other cultivated plants in Malaya.

The attack starts from a decaying jungle stump, but there are indications that the fungus can also germinate on, and spread from, heaps of damp leaves and twigs, and the writer has seen this

occur in Dominica. It may also run in the surface layer of the soil from one small root or dead twig to another. When it reaches the lateral root of a suitable living host, it grows up this and spreads around the collar, finally killing the plant. Often death is very sudden on trees such as limes; an apparently healthy tree may die within two or three days, retaining its withered leaves and presenting a scorched appearance.

The attacked roots and collar are covered with a dark felt of external mycelium which, in damp and shady spots, may extend up the stem of dead trees for a distance of from 6 in. to 2 ft. The advancing edge of the external mycelium is smoky grey, and the hyphae are light and cobweb-like in appearance; behind this the mycelium is denser and becomes dark olive green in colour, passing into a purplish black in the old parts. In damp places the older mycelium develops a mass of closely packed, black, hairy conidiophores projecting at a right angle to the stem. When ripe, the tips of the conidiophores are branched, and bear small white hyaline conidia, which give a grey or whitish appearance to the surface. Later, in damp sandy places, perithecia develop on the base of the stem above ground, sometimes to a height of 1 ft. or more above the soil; they are spherical, warty, black bodies, about 1·6 mm. in diameter, closely packed together and often partly buried in the mycelium. In the centre of each is a small smooth papilla, from the mouth of which ascospores are extruded in a black tendril. The spores, which are black, hard, boat-shaped, and have a long, fine, black appendage at each end, number eight in each ascus.

The mycelium penetrates, at a short distance from its advancing edge, through the bark of the root or stem of the host plant, and ultimately also traverses the wood, which becomes dry and light, the bark being almost completely rotted. The fungus penetrates in the form of black mycelial cylinders about 0·5 mm. in diameter, running transversely through bark and wood. In radial sections of the diseased plants. the penetrating mycelium appears as black lines running inwards in the bark and wood; in tangential section, however, it appears as black dots; this appearance in section is somewhat characteristic.

The treatment of this disease is the same as that for root diseases in general. The infected area, including a 2 or 3 ft. wide margin of apparently unaffected soil, should be carefully isolated by a trench 2 ft. deep and 1 ft. wide, all the earth from the trench being thrown inside the infected patch. All the plants within the patch should then be dug out and burnt, with as much as possible of the surface cover of leaves and twigs. The patch should be limed at the rate of about two tons per acre, and should be well forked over, removing and burning all bits of wood and roots in the soil. The isolating trench must be kept as free as possible from leaves and twigs. It would probably be safe to replant land thus treated after an interval of twelve months.